

## CLAIMS

What is claimed is:

1. A fuel cell comprising:  
a membrane electrode assembly including an ionically conductive member  
and an electrode, said electrode having an active area comprising a catalyst;  
a flow field having a plurality of flow paths facing said electrode;  
said catalyst distributed in said active area along at least one said flow  
path in a non-uniform loading such that electrochemical activity varies along said  
flow path.
2. The fuel cell of claim 1, wherein said flow path directs a gaseous  
reactant along said active area of said electrode.
3. The fuel cell of claim 1, wherein said flow field further comprises an  
inlet and an outlet; and  
said at least one flow path traverses said active area between said inlet  
and said outlet, wherein said catalyst loading increases with a distance from said  
inlet.
4. The fuel cell of claim 3, wherein a catalyst loading at an inlet of one  
flow path differs from a catalyst loading at an outlet of an adjacent flow path.

5. The fuel cell according to claim 1, wherein the catalyst loading varies along all flow paths of the plurality of flow paths.

6. The fuel cell according to claim 1, wherein said active area of said electrode includes a peripheral region and a central region, and said catalyst loading is less in said peripheral region than said central region.

7. The fuel cell according to claim 1, wherein said active area of said electrode includes a plurality of stripe-shaped regions with a first portion of said stripe-shaped regions having an increased catalyst loading as compared to a second portion of said stripe-shaped regions.

8. The fuel cell according to claim 1, wherein said active surface of said electrode includes a plurality of dot-shaped regions with a first portion of said dot-shaped regions having an increased catalyst loading as compared to a second portion of said dot-shaped region.

9. The fuel cell according to claim 1, wherein said catalyst is comprised of Pt, Pd, Pt/transition metal alloys, and combinations thereof.

10. A fuel cell comprising:

a membrane electrode assembly including an ionically conductive member and an electrode, said electrode having an active area comprising a catalyst; and

a flow field having a plurality of flow paths facing said active area of said electrode;

said catalyst distributed in said active area in a non-uniform loading such that catalyst loading associated with one flow path differs from catalyst loading of a next adjacent flow path.

11. A method of controlling reactions in a fuel cell, comprising:

providing a proton exchange membrane sandwiched between a pair of electrodes, at least one of said electrodes having an active area comprising a variable catalyst loading; and

providing an electrically conductive fluid distribution element having a flow field facing said at least one electrode;

wherein said variable catalyst loading provides localized control of a reaction rate in respective regions of said flow field.

12. The method of claim 11, wherein said variable catalyst loading is varied based upon a desired rate of water production in said respective regions.

13. The method of claim 11, wherein said variable catalyst loading is varied based upon a desired current produced by said cell.

14. The method of claim 11, wherein said variable catalyst loading is varied based upon mass flow of a constituent in said respective regions.

15. The method of claim 14, wherein said variable catalyst loading is arranged in proportion to said mass flow.

16. The method of claim 14, wherein said variable catalyst loading is arranged in inverse proportion to said mass flow.

17. The method of claim 11, wherein said variable catalyst loading is distributed on said active area of said electrode according to an amount of heat produced at various portions of said active area.

18. The method of claim 11, wherein said electrically conductive fluid distribution element comprises at least one material selected from the group consisting of a metal, a composite material, and a polymeric material.

19. The fuel cell of claim 11, wherein certain ones of said regions of said electrically conductive fluid distribution element are cooled and said variable catalyst loading is varied according to the reaction rate and the extent of cooling.

20. A method of controlling a current density in a fuel cell comprising:  
providing an electrically conductive fluid distribution element with a flow field;  
providing an membrane electrode assembly including an ionically conductive member and an electrode; and  
varying a catalyst loading of said electrode according to a geometry of channels included in said flow field.

21. The method of claim 20, wherein said catalyst loading is further varied according to at least one criterion selected from the group consisting of:

a material of said electrically conductive fluid distribution element, an amount of heat produced by an electrochemical reaction of said fuel cell, and an amount of water produced by said electrochemical reaction.

22. The method of claim 20, wherein said catalyst loading is varied according to pressure variations in channels of said flow field.

23. A method for varying catalytic activity along a surface of a membrane electrode assembly (MEA) having a catalyzed electrode and a constituent flow path adjacent to said catalyzed electrode, said method comprising providing said catalyzed electrode with a catalyst characterized by catalytic activity that varies in proportion to catalyst loading; and varying the catalyst loading of said catalyzed electrode along said flow path.

24. The method of claim 23, wherein the flow path includes regions of relatively low constituent concentration and regions of relatively high constituent concentrations, and said loading is greater in said low constituent regions.

25. The method of claim 23, wherein the flow path has regions of relatively high pressure and regions of relatively low pressure, said catalyst loading is greater in said low pressure regions.

26. The method of claim 23, wherein said flow path has regions of relatively low water accumulation and regions of relatively high water accumulation, and said catalyst loading is less in said high water accumulation regions.